

Dennis, (F. S.)

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upon the Technique
of an Aseptic Surgical
Operation.

*A Clinical Lecture Delivered in the Carnegie
Laboratory.*

BY

FREDERIC S. DENNIS, M.D.,

PROFESSOR OF PRINCIPLES AND PRACTICE OF SURGERY IN THE BELLE-
VUE HOSPITAL MEDICAL COLLEGE.

[Reported by DR. H. SEYMOUR HOUGHTON.]

*Reprinted from the Journal of the American Medical
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SOME PRACTICAL HINTS UPON THE TECHNIQUE OF AN ASEPTIC SURGICAL OPERATION.

GENTLEMEN.—In finishing, this morning, the winter course of lectures upon the Principles and Practice of Surgery, I propose to give you some practical hints. These hints will have reference to the antiseptic precautions which should be observed in the performance of any surgical operation of great or small magnitude. If the principles upon which antiseptic surgery is based are true—and there is no doubt upon this point—it is necessary to observe the same care in opening an abscess as in opening a major joint or exposing the peritoneal cavity. You have doubtless been bewildered by all the suggestions which you have listened to from different surgeons in reference to the various methods of employing antiseptics. In my remarks to-day I shall confine myself to the different steps which should be observed in every surgical operation, if sepsis is to be avoided and primary intention is to be secured. I shall assume at the outset that you are all believers in antiseptic surgery, and that the ocular demonstration of the causes of decomposition and putrefaction, which you have seen here this session in the Carnegie Laboratory, have proved conclusively to your minds the truth of this great system of surgery.

At the beginning of the term you saw cultivations of the different micro-organisms upon Koch's sterilized jelly and other media. These micro-organisms were found in the air, in the water, and in the soil, and these same micro-organisms have been demonstrated to you to be the cause of putrefaction. You have seen in the clinics the beautiful results of sur-

gical operations where means have been employed to prevent the access of these micro-organisms in wounds during an operation. You observe to-day that the infusions of beef in these test tubes, which were sealed last September, are as fresh this spring as they were last autumn. These pipette bulbs, which I exhibited to you in the autumn, are here again upon the table before me, and they remain unchanged. No decomposition has taken place in the infusion which I sealed in glass tubes last August in Prof. Tyndall's laboratory in London, under the direction of Mr. Cottrell. These infusions of beef and of turnip are just as pure to-day as they were last summer. You also observe that this flask containing beef-tea, which was sealed last September, is still fresh and pure. I told you that I had seen flasks containing beef-tea which had been kept for ten years, and that there was no trace of decomposition in the infusion. All of these infusions contained in these various flasks upon this table have remained for months free from any contamination, and they will keep forever fresh and pure, because the micro-organisms which float in the air are prevented from coming in contact with the fluids.

The micro-organisms which cause the decomposition in the beef-tea, and milk and vegetable infusions, cause putrefaction in surgical wounds, and when the surgeon is enabled to operate under conditions which prevent the access of these germs into the wound, he will succeed in obtaining primary intention, in preventing suppuration, which is due to the presence of these germs in the wound. We have studied together this subject carefully during the present session, and I shall now endeavor to make a practical application of this knowledge to the treatment of surgical wounds.

In order to observe the small details of antiseptic surgery, one must have a sublime faith in its belief; because the smallest omission, insignificant as it may

seem at the time, may be the cause of a complete failure. You will find some opposition to antiseptic surgery among a certain class of surgeons even at the present day. These surgeons will tell you that for over a half a century they have operated and with no precautions to prevent septic infection, and yet their patients lived, and the wounds healed. Many of you, upon your return home, will find that your preceptors are still unwilling to accept the modern views of the day. They will even deride you for the punctilious manner in which you conduct an operation, and boast that their cases recover without all the red tape and paraphernalia which you have been taught to observe. They even look upon you in disdain, and consider all your precautions as a species of pedantry characteristic of newly-fledged doctors. No great revolution has ever been undertaken without opposition; no reformation has ever been brought about without antagonism. As this is true in the political world, so it has its analogy in the science of surgery. The opposition and antagonism are to be overcome, not by argument, but by persuasion, and by a reference to clinical facts. Compare the results obtained by the practice of antiseptic surgery of the present time with the results obtained by the older practice of fifty years ago, and an appeal to these facts in a kindly spirit will win over men when arguments will cease to convince. It is natural that men imbued with certain principles from their earliest days in the profession, will not change those views, which have already become fixed, to accept other views foreign to their education, and which views they are expected to accept upon the faith of others. You are to anticipate this opposition, and you are to meet it in a kind and friendly manner; and the time is not far distant when these very men will be convinced of their error.

Before considering in detail the steps necessary to the performance of any important surgical operation,

I wish to call your attention to a practical point: always study your patient well before operating upon him or her. There is a good deal besides antiseptics to heed. The victory is not always due to the right use of antiseptics; but other factors enter largely into the calculation. Avail yourself of every possible means which will favor your patient. To this end examine carefully into the personal history. A knowledge of the condition of the heart, lungs, kidneys, and other organs, is essential. You should study his habits of mind and body, allay any anxieties on his or her part, assure the patient that all will be well, and encourage him or her in the hope that a speedy and certain recovery may be confidently expected. If the conditions of the patient do not justify you in such sanguine assurances, modify them according to the individual circumstances of the case, and use judgment and discretion. I believe that the mental condition of a patient has much to do with the prognosis, and that too much importance can not be attached to this fact. In every case you should aim to secure primary intention in the wound, with no constitutional disturbance, and for the accomplishment of these objects let me now direct your attention.

In every surgical operation, besides the general principles already enunciated, there are certain details to be observed, if the operation is to be aseptic, and the carrying out of these details will be considered under six different heads:

First. The disinfection of the operating room.

Second. The purification of instruments, etc.

Third. The preparation of antiseptic dressings.

Fourth. The disinfection of patient.

Fifth. The disinfection of operator.

Sixth. The application of the surgical dressing.

First. The Disinfection of the Operating Room.—The day before the performance of any capital operation, especially if it be one in abdominal surgery,

I would recommend the disinfection of the operating room. The room should first be scrubbed and dusted and made ready for an operation. I have used burning sulphur for disinfection. The sulphur should be placed upon an iron tray, which is set upon another and larger tray, and the sulphur is then to be ignited. The tray should be placed in as close contact with the ceiling as is safe from fire, and the fumes of the sulphur will descend and fumigate the entire room. It is useless to place the tray upon the floor, because the gas will not ascend and no disinfection will be accomplished. With regard to the room in which an operation is to be performed in the country: In this case the necessity for disinfection is not so great; but if there has been any sickness in the house or any epidemic in the neighborhood, this process of fumigation is simple. A small room should be selected with southern exposure and the carpet and hangings removed, and sulphur can be burned for a few hours previous to a capital operation. If the room has been carefully scrubbed, cleaned and dusted, and then disinfected, you are safe from any local infection. It is always best to remove the carpet and hangings, because you need only a kitchen table and a stand in the room, and the continuous irrigation will do no damage if all the furniture is removed. The sheets and blankets for use during the operation should be loosely thrown upon the table during the fumigation. To some this step may seem superfluous and unnecessary; but in the event of a great operation every possible precaution should be taken to protect the patient from any infection, and no step is superfluous which has for its object the prevention of septic infection following any surgical operation.

Second. Purification of Instruments, Ligatures, Sutures, Sponges, etc.—Too much importance cannot be attached to a careful cleansing of all instruments for use during a surgical operation. Instruments for perfect

disinfection should be of solid metal. The blade and handle should be of one piece and consist of a polished surface. I have abandoned the use of all instruments with ivory or pearl or wooden handles. They cannot be perfectly disinfected, and therefore the metal handles should be substituted. As far as possible forceps, and scissors, and all other instruments should be made to be taken apart and disinfected. I have here upon these tables a most elaborate display of surgical instruments, kindly sent at my request by Mr. W. F. Ford for purposes of illustration. Every instrument is made with the one object in view, and that is thorough and complete disinfection. All scalpels are made of one solid piece, and the handles belonging to the saws and chisels are solid metal. I should recommend you to purchase all instruments so constructed as to permit of perfect disinfection. Before an operation all the instruments to be used should be placed in a glass tray such as you see upon this table. I have requested Mr. Ford to import these glass trays from Germany, as they cannot be obtained in this country. Any glass or porcelain dish can be employed for the instruments; but these are so inexpensive and convenient that they will be found a valuable acquisition. Into these clean glass trays a solution of carbolic acid should be poured, of the strength of 1-20. There should be enough of the solution to completely cover the instruments, which should remain in this disinfecting fluid for an hour or two before an operation. The grease or dirt upon the instruments often prevents the carbolic acid solution from disinfecting certain parts of the metal, and for this reason it is well to let the instruments soak for some time in the solution. Just before operating this solution may be diluted one half with warm water, 1-40, in order to avoid its destructive effect upon the hands of the operator. Carbolic acid is found to be the least injurious to the instruments as a disinfectant, and bi-

chloride of mercury has been demonstrated to be most deleterious. The ligatures for use should also lie in another small glass tray which has a solution of carbolic acid, 1-20. As catgut is liable to become soft and unfit for use in carbolic acid solutions, it is best to preserve it, when not in use, in oil of juniper. About half an hour before operating, the catgut may be immersed in sublimated alcohol—i. e., hydr. bi-chlor. gr. vijss to alcohol oj— and kept soaking there during the operation. Catgut is the best material for ligatures, as it is aseptic, will not cause irritation and becomes absorbed. Catgut has been shown to be the starting point of infection, and therefore it should be obtained from a most reliable place. Catgut cannot well be prepared, and should be purchased only as needed. Silk ligatures, which can be used when the catgut cannot be procured in an emergency, can be, however, prepared by the surgeon without much difficulty. The formula given by Mr. Cheyne is a most useful one: take nine parts of beeswax, one part of carbolic acid, and melt these together. Let the silk lie in this until it is fully impregnated with wax and carbolic acid, then draw the silk through an aseptic towel and the friction will remove the superfluous wax. The ligatures can be cut and placed in a solution of carbolic acid, 1-20. The sutures can be made of catgut, or horsehair, or silk, or silkworm or silver; but whichever variety is used, the suture must be thoroughly disinfected, as well as the hare-lip pins. The lead buttons may be used to prevent tension in large wounds. The drainage is most important in every wound. This can be accomplished by means of tubes or by capillarity, as introduced by Mr. Chiene, of Edinburgh.

The drainage tubes may be of rubber, and the red rubber is preferable because this kind of rubber tubing contains no free sulphur. The tube should vary in length and diameter according to the size, character and situation of the wound. The tube

should have holes cut in it at short distances, and the tube when introduced into a wound should not project beyond the surface of the body, otherwise the tube is pressed upon by the dressings and bandage and the lumen of the tube is occluded. If the rubber tube is left too long a time in the wound it may become adherent to the wound by a process of adhesive inflammation and tear off, and part of the tube is then left behind in the bottom of the wound. This unpleasant complication I have lately had happen to me on two occasions, though the tubes were withdrawn within the required time. To obviate this accident I have of late used a tube made by Mr. Ford at my suggestion, consisting of pure ivory. This is polished smoothly upon its outer and inner surfaces. This tube will not collapse like the rubber tube, nor tear off, and possesses the special advantage that it can be used more than once, as the ivory tube can be as thoroughly cleansed and disinfected for use in several operations. These tubes should be introduced by Lister's sinus forceps, and fastened by a disinfected safety-pin.

Drainage by capillarity is employed by strands of catgut which absorb blood and serum, but not pus. The threads of catgut are collected into a bundle, and this kind of drainage is not removed as the tubes are, since the catgut becomes absorbed. The ends of the catgut are left outside so as to produce a siphon action. Horsehair is also used instead of catgut; but the horsehairs are removed from time to time as it seems necessary.

Another method of absorbable drainage was introduced by Neuber, of Kiel. This consisted of bone tubes which were decalcified. An improvement to these tubes has been made by Mr. MacEwen, of Glasgow. The method of preparing these tubes as described by him is as follows: "The tibiae and femora of chickens are scraped and steeped in hydrochloric acid and water, 1-5, until they are soft. Their

articular extremities are then snipped off with a pair of scissors; the endosteum is raised at one end and pushed through to the other extremity, along with its contents. They are then re-introduced into a fresh solution of the same strength until they are rendered a little more pliable and softer than what is ultimately required (as they afterwards harden a little by steeping in the carbolized solution). When thus prepared they are placed in a solution of carbolic acid in glycerine, 1-10." In ten days they are ready for use after holes have been punched in them. The tubes will last longer if instead of carbolic acid chromic acid is employed.

Protective oiled silk should be used over the line of suture to prevent the irritation of the carbolic acid, and also to prevent adhesion of the dressing to wound. This protective oiled silk can be made in the following manner as described by Sir Joseph Lister: Take ordinary oiled silk, paint it over with copal varnish, and when dry brush over the surface a mixture consisting of one part of dextrine, two parts of powdered starch, and sixteen parts of carbolic acid, 1-20. Carbolic acid will not permeate the oiled silk if the varnish is added, and the mixture permits the piece of protective to be moistened throughout so that dust will not collect in places upon the protective, as it does when the mixture is not employed.

The sponges to be used in every operation must be carefully disinfected, otherwise they may become prolific and dangerous sources of infection. The process of cleaning, bleaching and disinfecting sponges is very complicated, and I would suggest to you that the druggist do this, and when he has prepared them for you to carefully disinfect them, as this can be easily done by allowing them to stand in a glass fruit jar containing a solution of carbolic acid, 1-20. The jar should be thoroughly disinfected before using it for this purpose, and it should be her-

metically sealed at once and not opened until the operation. Any sponges which have been thus prepared and used can be cleaned by allowing them to stand in water a few days, and this will decompose and wash out the fibrin contained in the meshes of the sponges, and then they are again put up in the hermetically sealed glass jars. The employment of sponges a second time may be considered safe, if the disinfective process is carefully carried out; it is, however, best in every great operation to prepare fresh new sponges.

Third. The Preparation of Antiseptic Dressings.
—There has always been more or less mystery, to say nothing of the expense, about the preparation of antiseptic dressings. It has been thought impossible to obtain them except through some especial agency. There is neither mystery nor expense about the preparation of these dressings, and I shall give you a few hints so that you can prepare them for any case and with but small expense. Every surgeon who practices antiseptic surgery has some modification of his own, and I shall only give you some general hints about the preparation of the dressings, so that you can have at command an easy and simple way of making antiseptic dressings. Bandages can be made by soaking cheese cloth for twenty-four hours in a solution of bichloride of mercury, 1-500, or carbolic acid, 1-20. The cheese cloth should be torn and rolled, and then disinfected again and wrapped in parafine paper and kept in an ordinary tin box, so that the bandages are kept from the air. Naphthaline gauze dressing is made by dissolving the crystallized naphthaline in alcohol (in saturated solution), but never in turpentine, as it is too irritating, and allowing the gauze or mull, which must be free from fat and acids, to soak for a day. This dressing is then dried by allowing the alcohol to evaporate, and the naphthaline powder will become crystallized.

and then wrapped in the parafine paper and placed in a tin box.

Carbolized gauze can be made by using parafine, resin, and carbolic acid, and soaking the gauze in this mixture. Instead of using the gauze or mull, it is better to buy the von Brun's hospital gauze, which comes already prepared, and then disinfect it. The ordinary gauze must be subjected to some process to free it from the acids and fats, and this has already been done in the von Brun's gauze. The iodoform gauze is prepared by dipping the ordinary von Brun's hospital gauze, which can be purchased from any wholesale druggist, first into a bichloride solution, 1-1000, for a day, and then into a solution of alcohol and glycerine equal parts. The excess of alcohol is forced out by pressing and the iodoform powder is rubbed well into the gauze, when it is spread out upon a large plate of glass. Or the iodoform may be placed in a bowl and the damp gauze kneaded with the hands until the iodoform is evenly distributed in the meshes of the gauze. Bichloride gauze is prepared by soaking for twelve hours the von Brun's hospital gauze in a solution of bichloride of mercury, 1-500.

Combined dressings can be made by placing a thin layer of borated cotton between two layers of the gauze, which may have been soaked previously in naphthaline, or iodoform, or bichloride of mercury, according to the kind of antiseptic dressing required. There are, of course, many other ways of preparing surgical dressings, but any surgeon, by following these simple instructions, can prepare for himself antiseptic dressings, and also find himself independent in this most important matter. All these dressings, while they can be made aseptic, have one objection in common, and that is the irritating effects upon the skin of certain individuals, and while this is oftentimes a serious objection, at present these dressings are the best we have. I have found the naphthaline

in alcohol the only dressing which is less likely to irritate the skin.

Fourth. The Disinfection of Patient.—Any part upon which an operation is to be performed is to be made perfectly clean and aseptic. With this object in view the surface is to be washed well with soap and warm water, and then thoroughly scrubbed with a clean nail brush. After the scrubbing, which will remove the grease and dirt and epithelium from the surface, the part should be cleanly shaved with a sharp razor and then again washed, after which ablution the parts should be disinfected with a solution of bichloride of mercury, 1-500. This solution should be used freely and should be irrigated over the parts from an irrigator which is suspended. The vessel should be placed upon a shelf about six feet above the floor. The strength of bichloride can be 1-500 for the skin; but over a wound 1-2000 is of sufficient strength. If a joint is to be washed out 1-10,000 is strong enough, and if the peritoneal cavity is to be irrigated the solution should be very weak, as the extent of absorbing surface is very great. A part of the intestine could be irrigated by a solution of 1-10,000 if outside of the cavity of the peritoneum; but any solution within the cavity must be very weak. Boro-glycerine is the best solution for the peritoneal cavity. Patients are salivated by a continuous irrigation over an extensive wounded surface.

A rubber cloth is a necessary article during an operation. This should be well washed before using with a solution of carbolic acid, 1-20, or a bichloride solution of 1-500. The rubber sheet should be placed under the patient so as to be above the part to be operated upon, and should be gathered up and fastened by safety pins and the lower end be over a pail in order to catch the solution as it is irrigated over the parts before and during an operation. Long sand bags placed under the rubber sheet will form an

artificial trough through and along which the irrigating fluid can flow. If the front legs of the operating table are elevated by placing two bricks or wooden blocks under them the force of gravity will cause the fluid to descend and fall into the pail or any receptacle at the end of the table. Clean towels should be wrung out in a warm solution of bichloride, 1-1000, and placed above and below and upon both sides of the part of the body to be operated upon, and fastened at the corners with safety pins so that the wound will not be touched with any part of the body, or any clothes upon the patient may not come in contact with the wound. Any instrument or sponge thus cannot come in contact with any surface which is not disinfected. After an operation all these blood-stained towels should be removed and clean ones substituted before any permanent dressing is applied. A saturated solution of iodoform and ether or naphthaline and ether can be poured over the part before an operation; but after a thorough disinfection of the part in the manner already described. From the beginning to the end of an operation continuous irrigation should be kept up, so that the parts, and instruments and sponges and ligatures are continually saturated, and thus protected from any possibility of carrying infection. The strength of the irrigating fluid must be graduated according to the character and situation of the wound. This fact should never be lost sight of, that a safe irrigation for the skin is dangerous for a joint and fatal to the peritoneal cavity. The strength, then, of a solution for continuous irrigation must of necessity vary according to the nature of the part to be irrigated. As it is very desirable to have at hand a ready means of making these solutions, the formulæ of the two most frequently used will be appended:

1. For the *bichloride*, the surgeon should prepare a solution of mercury in glycerine as follows:

R.	Hydr. bichlor.	℥ij.
	Glycerine.	℥iv.
M.		

This will give a strength of half a grain to the minim, so that, using this as a standard, and recollecting that 8 grains to the pint corresponds to 1-1000 (approx.), a solution of any strength may be readily computed. Thus, to make 1-1000, it is only necessary to add 16 minims of the glycerine solution to a pint of water, and this in turn may be diluted to any extent.

2. As alluded to above, the use of mercuric solutions is not devoid of danger, and hence, for other than surface irrigation—as in washing out suppurating cavities, *i. e.*, empyema—a milder and less irritating antiseptic is to be preferred. The material best adapted for this purpose is *salicylic acid* according to the formula of Prof. Thiersch:

R.	Acidi Salicylici.	℥ss.
	Acidi borici.	℥ss.
M.	Ft. pulv. No. 1.	

These powders may be kept on hand, and adding one to a quart of warm water, a solution of convenient strength is secured.

Fifth. The Disinfection of the Operator.—The surgeon and every assistant should be scrupulously clean. The hands should be washed in warm water and soap and scrubbed well with a nail brush and then dipped into a vessel containing carbolic acid or bichloride of mercury. After the hands have thus been washed and the finger-nails cleaned and then disinfected, no towel should be used to dry the hands, for the towel itself may become a source of danger. A rubber apron, previously disinfected, should be worn, and over this a clean white linen apron should be placed, which apron has been carefully prepared by a competent nurse. What has been said in reference to the operator and his assistants is likewise applicable to the trained nurse who is in attendance upon the case, as well as all others who assist in the toilette of the patient. In pointing out these few practical hints

in reference to the preparations which should be made for every surgical operation. I do not wish that it should be understood that there is any desire to adhere to one antiseptic solution in preference to others, or to commit myself to any one solution.

The solutions which have been recommended in the lecture this morning are those which up to the present time have been found by the majority of surgeons to be the most satisfactory when all things are taken into consideration. I do not hesitate to state that in my own experience I have seen serious trouble arise from the use of any and all of these solutions. In this bottle is urine which is nearly black, and it was voided by a patient who was obliged to submit to paracentesis thoracis, and the spray of carbolic acid for a few moments thrown upon the chest wall had given rise to this condition of urine. The use of carbolic acid as a disinfectant not only poisons the patient occasionally, but it has been known to produce acute albuminuria in surgeons. Thus it is evident that carbolic acid, while it is the best disinfectant for instruments, sponges, and the surgeon's hands, has nevertheless some serious objections.

Bichloride of mercury is most useful for continuous irrigation, and is perhaps one of the best germicides that can be employed; but it, too, has its objections. Bichloride of mercury ruins surgical instruments, will often produce salivation of patient, and more often will excoriate the skin over whatever part it is used in a dressing.

The question naturally suggests itself to you at this point, what is the best solution to use? I have found sulphurous acid the best for continuous irrigation; but while it is the most efficient germicide, the gas cannot be kept in solution for the purpose of making surgical dressings as the gas escapes from the gauze. Hyposulphite of soda is another excellent solution, and possesses the special advantage of being

useful as a disinfectant for instruments, the hands of the operator, for the preparation of surgical dressings and for continuous irrigation; but it has one great disadvantage which prevents its use, and that is the slippery feeling it gives to ligatures and to the surgeon's fingers. Naphthaline is also good for dressings; but it is difficult to get a pure article, and the impure powder is deleterious. I have mentioned these facts simply to show how difficult it is to procure one solution which is applicable for disinfecting instruments without injuring them, for washing the hands without producing unpleasant effects, and finally, for preparing surgical dressings. It is for these reasons that I have already mentioned that up to the present time there is no one germicide which can be used in common for disinfecting instruments, purifying the hands, and preparing dressings. The subject of an efficient germicide with no disadvantages is one still under consideration by surgeons, and until such a perfect germicide is discovered we must be content with what we have at present in use, and employ our solutions with great care and avert as far as possible the serious objections which we find in their use.

An ideal solution is one which can be employed for disinfecting instruments and ligatures and sponges without detriment, and at the same time be used for continuous irrigation without injury to the patient or to the surgeon, and also one which is easily made and which is economical, and which will not become volatile or render the fingers slippery, or lose its germicidal effect by evaporation. It will be a great advance in antiseptic surgery when a single solution is discovered which will answer all the essential conditions. The great principles of antiseptic surgery will thus be simplified and within the reach of all to carry out in daily surgical practice. The great difficulty heretofore in carrying out the principles of antiseptic surgery in the practice of those not espe-

cially educated in this department of surgery has been in the fact that there has been no unanimity of opinion among surgeons as regards the relative value of the different germicidal solutions. Another difficulty has arisen in the fact that one solution of a certain strength must be employed for instruments and another solution for the surgeon, and still another for irrigation, and again another for the dressings. This has led to confusion, and when an ideal solution is found all this technique will be simple instead of complex, and the merest tyro in surgery can carry out the principle upon which this great system of surgery is based.

Sixth. The Application of the Antiseptic Dressings.—Too much importance can not be attached to the permanent dressing after an operation has been performed in an aseptic manner. Carelessness on the part of the surgeon in the application of the dressings may result in complete failure to secure primary intention. The wound should be perfectly dry and free from all loose coagula before the sutures are introduced. The kind of drainage to be employed depends upon the character, situation, depth and size of the wound.

If the wound be small, as, for example, after osteotomy, the strands of catgut inserted into the bottom of the wound with the ends left hanging out of the lower angle of the wound will be found a most efficient and excellent method. If the wound, on the other hand, be large, then a red rubber drainage tube, or the ivory tube on the glass canula, will be found to be the best for providing an escape for the inflammatory exudates which are always present after an extensive wound. The sutures should be of catgut for small wounds; but silk-worm, or silk, or silver, should be employed in amputation wounds or any wounds of considerable size. It is not safe to rely upon catgut if there is likely to be any tension in the wound. I have found that catgut is good for super-

facial sutures, while the silk worm or silver, or even hare-lip pins, are best for the deep sutures.

After the edges of the wound are nicely and accurately adjusted by cutting away with a pair of scissors, curved on the flat, any loose fatty or connective tissue which insinuates itself between the lips of the wound, the sutures should be tied, and if any tension exists the button suture can be employed with great advantage. The surface of the wound should now be irrigated for the last time, and then iodoform or naphthaline powder be dusted over the linear incision and then protective placed over the wound, and finally a bandage, which is wet with a bichloride solution, wrapped around the part. The wound is now protected and the surrounding parts are to be carefully dressed. A layer of the combined dressing should now be made to envelop the part at a good distance in every direction from the original wound. This combined dressing should be made secure by an antiseptic bandage. If the wound be a fracture, a plaster-of-paris bandage can now be applied and a layer of torated cotton can be first wrapped about the whole limb before the plaster-of-paris bandage is applied.

If the wound be dressed in general in some such way as has been described, this first dressing need not be disturbed for eight or ten days, unless for the purpose of removing the drainage tube, which can be done without taking down the entire dressings. If the dressings be stained with serum, or there be any other discharge, this first dressing should be removed and a clean new one applied with every antiseptic precaution. It is well in every case to change the dressings after eight days, even if there seems to be nothing wrong. A neglect of this rule has been followed, in my own experience, by some unpleasant complications, and I believe that every surgical wound should be examined as a matter of precaution. I have seen serious trouble occur when a

fracture dressing was cut down at the expiration of six weeks; although there never was any evidence or sign of trouble during the six weeks. Whenever a dressing is removed and a new one applied the same attention to details and the same antiseptic precautions should be observed as during the application of the first and original dressing. Carelessness on this point has been followed by suppuration in a wound which had nearly completely healed by primary intention. Every surgical dressing, be it the first or the last, in the history of any wound, should be made with the same care and attention.

Another point seems to me of great importance in the treatment of every wound, and that is the maintenance of absolute rest to the part during the repair of the wound. The equable and uniform pressure upon the wounded part secured by the combined dressings which have been described, are inadequate to secure mechanical fixation to the part without the aid of splints so applied as to maintain physiological rest to the wounded part, as well as the parts in the vicinity of the wound. Every surgeon has his own peculiar way of applying his dressings, and the method which has been described is only intended to impress the general principles involved in wound treatment. The great principles of absolute rest, of free drainage, of uniform compression, of freedom from pain, of absence of constitutional disturbances, together with many other salient principles, are thus maintained by these simple rules in the application of surgical dressings.

Now, gentlemen, having completed the operation with every antiseptic precaution, you are justified in the belief that all will go on well to a successful and rapid recovery. Should anything happen to prevent primary intention in the wound, you must carefully search for the cause and remedy it at once. The triumphs of antiseptic surgery are so numerous and so uniform that the cause is to be found in the

omission on your part of some detail in the technique of the operation. Look always for the cause to some defect in your manner of operating, or in the use of your antiseptics. If you fail in your first attempts, inquire rigidly into the cause of failure, and do so with the positive assurance that the fault is with you and not with the patient or the system of surgery which you have attempted to practice. It is with this spirit that you should adopt the great principles of antiseptic surgery, and when you are fully convinced by actual experience what great things can be accomplished you will not wonder that hundreds of operations can be consecutively performed and the patients escape from septic infection. We can do now what could not be done a few years ago, and I trust that you may all participate in the great work, and contribute much to the science which we have studied together, and which offers to suffering humanity assistance such as never could be proffered before the introduction of antiseptics.

